METHOD AND SYSTEM FOR CONTROLLING THE DISTANCE OF A FIRST VEHICLE IN RELATION TO A PRECEDING VEHICLE

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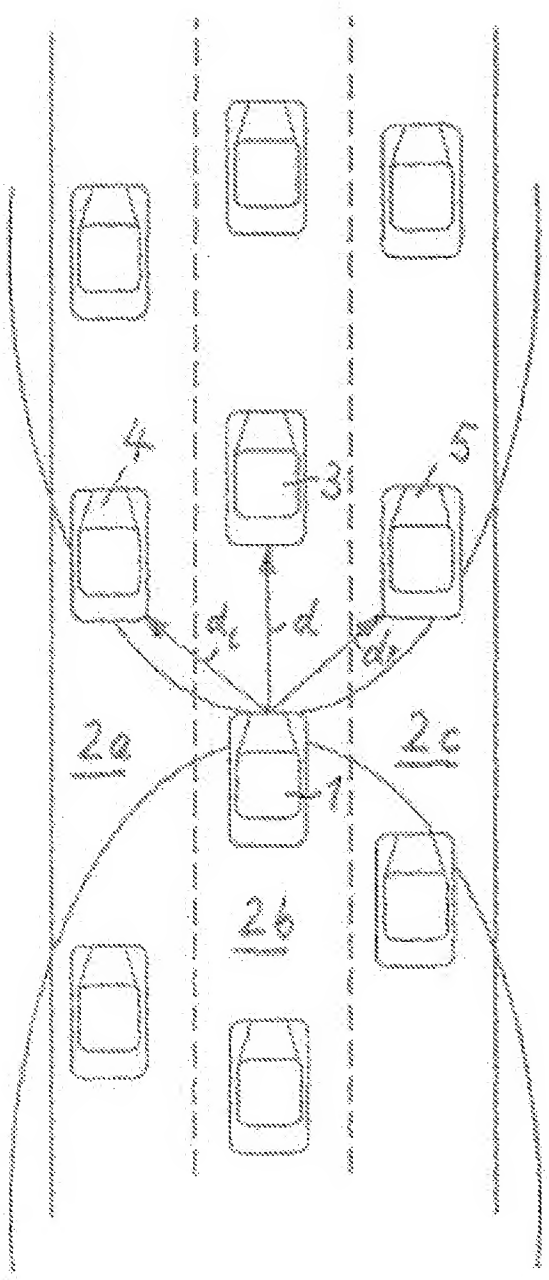
Abstract of WO 0198101 (A1)

The invention relates to a method for controlling the distance of a first vehicle in relation to another preceding vehicle. According to said method, vehicle state variables and characteristics, in addition to the distance and the vehicle speed of at least one other vehicle in the vicinity are detected and the distance to the other vehicle and the speed of the first vehicle is adjusted to permitted threshold values. To increase driving security, the speed of the first vehicle and/or its desired distance from the other vehicle directly preceding it is/are determined as a function of the vehicle speed of at least one other vehicle driving in a laterally offset manner and/or of the distance between several other vehicles driving in a laterally offset manner.



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Methods for the longitudinal control of a vehicle to one vo rausfahrenden foreign vehicle and spacer monitoring system the invention relates to a method for the longitudinal control of a vehicle and a spacer monitoring system after the preamble of Claim 1 and/or. 16.

With such spacer monitoring systems determined can become in response of the absolute speed of the vehicle as well as the distance to immediate preceding vehicles an automatic aimed speed which can be kept by the vehicle, which may not be exceeded by the subsequent vehicle. On the basis of the calculated aimed speed and other current vehicle variables of state actuating signals generated, by means of those the engine in the control system, if necessary become which transmissions and/or the brake means of the vehicle becomes the adherence to the aimed speed set. The determination of the aimed speed the distance between the vehicle and the preceding vehicle becomes determined over vehicle-own measuring A SMELLINg tung. A such spacer monitoring system is for example in the DE 42 09 047 Cl described.

The setting of the speed usually the relative distance becomes and/or. the relative speed to immediate preceding vehicles to reasons laid. In particular with travels on mehrspurigen roads it is to be considered however that due to different Kolonnenge schwindigkeiten on the various lanes with activated spacer monitoring system the vehicle speed hō be ago can as the column speed on the adjacent lane, with the sequence that the driver must reduce the manual vehicle speed, in order to prevent an unintended overhauling on the right lane.

An other problem can occur with a track switching, if the distance is larger to the preceding vehicle now direct on the new lane after carried out track switching as the distance to the preceding vehicle on the prior lane. The permissible vehicle speed can become perhaps by the spacer monitoring system TA tig increased whereby the danger of the Überho lens on the right lane to likewise develop can.

The invention is the basis the problem to improve driving safety in vehicles with independent spacer observance.

This problem becomes according to invention with a method with the features of the claim 1 and with a spacer monitoring system with the features of the claim 16 dissolved.

In accordance with the novel method the true airspeed of the vehicle and/or the target distance to that become direct preceding foreign vehicle, which is on the same lane, as function of the vehicle speed at least a lateral offset driving foreign vehicle and/or the distance between several lateral offset driving foreign vehicles certain. To place tigt with the determination of the desired values for the distance and the true airspeed the speeds and the distances of the vehicles on the adjacent lanes berücksich, whereby average velocities and average distances become favourable from a plurality of individual measurings determined, in order an uniform, steady adaptation of the distance and the true airspeed safer.

The distances between lateral offset driving cars become for example determined by measurement of the speeds the one on the other subsequent foreign vehicles as well as the measurement of the timed distance, with which the one on the other subsequent foreign vehicles at the own vehicle drive past.

The target distance between the own vehicle and that direct ahead driving car can if the distance between at least two lateral offset driving foreign vehicles is smaller than the current set target distance, on the distance between the lateral foreign vehicles reduced become, whereby convenient from safety reasons a predeterminable minimum value is to be kept, which can become driver-individual set, however an driver-independent lower bound not fall below may not. Likewise from safety reasons it can be displayed to reduce the target distance only for the case that the relative speed lies between the vehicle and a surrounding foreign vehicle below a predeterminable limit.

Over this spacer attitude the distance can become ahead the driving car to the distances between the lateral vehicles, which are on adjacent tracks, adapted. This is also possible for the case that the distance between at least two lateral offset fah renden foreign vehicles is larger as the current set target distance of the vehicle to the direct preceding foreign vehicle, as the target distance becomes enlarged on the distance between the lateral foreign vehicles.

The vehicle speed of a lateral offset driving foreign vehicle becomes favourable by the fact considered during the automatic spacer observance that the maximum permissible true airspeed of the vehicle becomes limited on the vehicle speed of the lateral offset foreign vehicle. Here becomes in particular the vehicle speed of the nearest, lateral offset foreign vehicle predetermined as maximum permissible maximum speed. Convenient ones become here only foreign vehicles considered, which regarding the vehicle in a certain, predetermined lateral direction to be, whereby in countries with right traffic favourably only the vehicles located on the left side of the vehicle become, in countries with left-hand traffic against it only the foreign vehicles considered located on the right side of the vehicle. Thereby different national traffic rules can become calculation carried, in order to prevent that the vehicle overhauls lateral offset driving cars on adjacent lanes in against the rules manner.

The limitation of the vehicle true airspeed on the speed of the lateral offset driving foreign vehicle can become both for the case applied that and the vehicle accomplishes a track switching of a roadway on the next, lateral adjacent roadway for the case to seize that the vehicle without track switchings follows by means of spacer monitoring system the preceding vehicle and on the adjacent lane in glei cher direction of travel of other vehicles is. In first dropwith a track switching first the track switching is detected on the basis the turn of the steering wheel or on the basis a corresponding change of the absolute position of the vehicle, in particular over a positioning system such as z. B. Government inspection department (global Positioning system), whereby for the moment the track switching the vehicle speed immediate preceding foreign vehicle on the same lane determined and as maximum speed of the stored becomes. After carried out track switching the true airspeed of the vehicle becomes limited on the stored maximum speed, so that the vehicle on the new lane cannot overhaul the foreign vehicles on the prior lane. Here again the direction of the track switching can become considered, by a limitation of the true

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airspeed only for the case performed will that the track switching is carried out into a particular direction, in opposite direction against it a limitation precluded will, in order to make an automatic increase possible of the true airspeed for the execution of a rule-conformal overhauling maneuver.

In addition, the limitation of the true airspeed can be favourable independent of a track switching with a vehicle remaining on a lane. In this case become not only the distance and the speed immediate straightforward preceding foreign vehicle, but also the vehicle speed of a preceding, however lateral offset foreign vehicle considered and the vehicle speed of the lateral offset foreign vehicle as maximum speed predetermined.

It can be convenient to plan criteria for the cancellation of the limitation on the maximum speed with a spielsweise or minimum period which can be determined which can be given, becomes canceled after whose flow the limitation.

In accordance with an other advantageous embodiment is provided that the distance to immediate preceding foreign vehicle, which is on the same lane, will determined and automatic on a permissible minimum target distance shortened becomes, which bottom safety aspects with consideration of the traffic conditions, adapted in particular is justifiable to the absolute speed of the vehicle. It is thereby situation avoided to become that a distance, which is to be kept over the spacer monitoring system and which is larger as the permissible minimum target distance, to situations leads, in those, set of the driver, vehicles into the gap between the vehicle and the preceding foreign vehicle in-sheared, which can perhaps lead to danger situations. Beyond that this method offers the advantage that driving "bumper to bumper" with maximum possible vehicle-dense bottom adherence to the relevant safety criteria performed to become to be able. This method can become also independent by lateral offset driving foreign vehicles performed if necessary.

The spacer monitoring system according to invention covers measurement means to the detection of the vehicle state quantities as well as characteristics of the own vehicle as well as to the detection of position and vehicle speed at least one foreign vehicle, Regel-und control unit, which is supplyable as input signals Zustands-und characteristics of the Eigenfahrzeu of ges as well as distance and vehicle speed of the foreign vehicle and becomes in in accordance with a deposited rule strategy the actuating signals generated, which vehicle actuators become for adjustment the permissible distance the preceding foreign vehicle supplied. The measurement means cover convenient means to the measurement of the vehicle speed of a lateral offset driving vehicle, whereby the true airspeed of the vehicle and/or the target distance to that are assignable direct preceding foreign vehicle as function of the vehicle speed of a lateral offset driving foreign vehicle and/or the distance between several lateral offset driving foreign vehicles.

Other advantages and convenient embodiments are the other claims to infer from the description of figure and the designs. Show: Fig. 1 a plan view on a vehicle with Abstandsre gel system, whereby the vehicle itself on a mehrspurigen road with a plurality of lateral and direct preceding foreign vehicles befin December, Fig. 2 a flow chart with the method for starting from condition regulation in case of a track switching to the right.

In fig 1 is a traffic situation on a mehrspurigen road with a plurality of lanes 2a, 2b and 2C shown, on which in each case are a plurality of vehicles, pointing into a direction of travel, which in driving "bumper to bumper" move. A vehicle 1, which is moved on the middle lane 2b of the road, with a spacer monitoring system equipped, which stood part-autonomous driving possible and vehicle state quantities and parameter various in response as well as outside conditions a defined to an immediate preceding, on the same lane 2b for located foreign vehicle 3 TA off in particular tig keeps itself. The distance between the vehicle 1 and that direct preceding foreign vehicle 3 may not fall below here a minimum distance, whatever in response of the true airspeed of the vehicle 1 and other conditions, for example environmental conditions if necessary, in the spacer monitoring system vehicle monitoring system of the vehicle 1 determined becomes.

The vehicle 1 is equipped with spacer measurement means, over which the distance is more measurable D to the direct preceding vehicle 3. The spacer measurement means possible it in addition to seize vehicles 4 and 5 which are likewise before the vehicle 1, however on the adjacent lanes 2a and/or. 2C on the left and on the right the middle lane 2b of the vehicle 1 drive. The distance to the vehicle 4 located on the left lane 2a is with dl designated, the distance to the vehicle 5 with Dr., located on the right lane 2C. The distance vector to the left vehicle 4 includes an angle opposite the longitudinal center axis of the vehicle 1; corresponding applies to the distance vector, which is 5 directed to on the right lane the 2C driving car. On the basis the angle inclusion between the distance vectors to the lateral offset driving cars on adjacent lanes opposite the longitudinal center axis of the vehicle 1 unique found can become whether one of the preceding foreign vehicles 3.4 and 5 on the same lane 2b is as the vehicle 1 or is lateral offset. In case of a lateral displacement the direction of the side transfer can become found.

Convenient ones are over the spacer measuring instrument also drive witness more detectable, which in direction of travel seen the rear vehicle 1 is. Also to the rear both immediate on the same lane 2b the rear vehicle driving cars and lateral offset, on the lanes can 2a and/or. 2C driving cars determined become. In particular in case of overhauling or driving vehicles it can be convenient to limit the true airspeed of the vehicle 1 favourably on the value for the moment the rear-end collision and/or. Overhauling determined instantaneous value of the true airspeed, and/or the driver a warning over the driving and/or. ūberho vehicles lenden to indicate.

An application of the method is to be taken from the flow chart after fig 2 for longitudinal control. In a first process step 6 first the distance becomes the immediate preceding, on the same lane located foreign vehicle measured over the vehicle-own spacer measurement means. The distance measurement can become here with the help of a radar mechanism, an infrared mechanism or over optical systems performed, which a camera to the optical detection of the foreign vehicle and an image processing system can cover to the evaluation of the picture.

After the measuring the distance a longitudinal control becomes and if necessary also a speed control performed in a subsequent process step 7. For this first a minimum distance becomes dmin determined, which may not be fallen below from safety reasons. The minimum distance dmin depends here in particular on the absolute altitude of the true airspeed v of the vehicle.

Convenient one becomes the distance on a target distance controlled, which is not smaller as the minimum distance dmin and for example from the driver predetermined can become. Case of the driver no desired distance predetermined will, can the actual distance D on the minimum distance dmin controlled become.

As other condition considered can become that the actual true airspeed v of the vehicle may not exceed a maximum speed Vmax. Case the permissible maximum speed Vmax is smaller as the actual vehicle speed of the direct preceding vehicle, then this condition for the setting of the vehicle speed has priority before the control of the distance; in this case the actual true airspeed becomes v on the maximum speed Vmax limited, even if with this true airspeed the desired distance is not to be kept v to the preceding vehicle.

The maximum speed Vmax can become for example from telematics systems determined. In addition, it is possible to give the maximum speed vehicle-specific to avoid for example in order a exceeding of the permissible maximum speed the current

drawn up vehicle tyre. The maximum speed can become also by the driver influenced and predetermined. Beyond that it is possible, Umwelt-und of other outside influences, for example the weather to include into the determination of the maximum speed Va.

If no maximum speed becomes Vmax predetermined, no condition for the vehicle speed must become satisfied during Abstands-und speed control, so that the immediate desired target distance can become set. The target distance and gegebe nenfalls the ideal velocity of the vehicle become by the generation of actuating signals, those the engine, which becomes transmissions and/or the vehicle brake supplied, set.

In the following process step 8 becomes found whether the vehicle accomplishes a track switching. This can be detected to the one on the basis the steering wheel angle, by the current steering wheel angles with a in particular speed-dependent limit compared will and a track switching for the case becomes found that this limit is exceeded. In addition from the sign of the steering wheel angle found can become whether a track switching becomes on the left or on the right lane performed.

A track switching can do alternative ones or additional also by means of a positioning mechanism, for example government inspection department, over which the current absolute position of the vehicle can become found, and a digital card, which contains a road system with sufficient accuracy, certain become.

In the following process step 9 is queried the direction of the track switching. It can become thereby different national controls calculation carried, in order to ensure that becomes performed after a track switching during still activated or again activating longitudinal control of the vehicle no illegal overhauling procedure, for example by overhauling on the right lane.

In process step 9 it is queried whether a track switching on the right lane performed is. Case this not the case is, becomes the no branch corresponding the beginning of the method the first process step 6 returned. In this case no additional boundary condition-resultant become from track switching for the true airspeed of the vehicle for Abstandsund speed control predetermined.

Case however a track switching found is to the right, the yes-branch of the process step 9 corresponding to the process step subsequent on it 10 is continued, in accordance with which the speed of the direct preceding foreign vehicle becomes at the moment the track switching determined and stored as maximum speed vmax. Following process step 10 again first process step 6 returned and entire procedure again gone through, whereby in the process step 7, in which Abstands-und becomes speed control performed, the maximum speed becomes Vmax as auxiliary boundary condition considered.

By the consideration of the vehicle speed of the foreign vehicle as maximum speed Vmax ensured is to become that with a track switching on the right lane the vehicle does not accomplish an illegal overhauling procedure on the right lane during activated longitudinal control. Since the true airspeed cannot exceed the maximum speed Vmax, an overhauling procedure on the right lane is precluded.

It can be convenient if necessary, the limitation on the maximum speed Vmax only for a certain period upright to obtained, whereby this period can be both a fixed predetermined period and a variable determining period. It is in particular favourable to give an abort condition for the default of the maximum speed of the fact it consists which convenient that by means of the measurement means in the vehicle additional to the speed of the direct preceding vehicle also the speed of the lateral offset, preceding vehicle measured will and a continuous adaptation of the maximum speed becomes the corresponding speed of the lateral offset driving foreign vehicle performed.

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Claims 1. Methods to the control of the distance of a vehicle to a preceding foreign vehicle, with the vehicle state quantities and vehicle characteristics as well as the distance and the vehicle speed of at least a surrounding foreign vehicle (3,4,5) detected become and the distance the foreign vehicle (3,4,5) and the true airspeed (v) of the vehicle (1) on permissible limits set, characterised in that the true airspeed (v) of the vehicle (1) become and/or the target distance to that direct preceding foreign vehicle (3) as function of the vehicle speed at least a lateral offset driving foreign vehicle (4,5) and/or as function of distance between several lateral offset driving foreign vehicles (4,5) certain become.

2. Process according to claim 1, characterised in that if the distance between at least two lateral offset driving foreign vehicles is smaller than the current set target distance of the vehicle (1) the direct preceding foreign vehicle, the target distance on the distance between the lateral foreign vehicles reduced becomes.

3. Process according to claim 2, characterised in that the target distance only up to a predeterminable minimum value reduced becomes.

4. Process according to one of claims 1 to 3, characterised in that if the distance between at least two lateral offset driving foreign vehicles is larger as the current set target distance of the vehicle (1) the direct preceding foreign vehicle, the target distance on the distance between the lateral foreign vehicles enlarged becomes.

5. Process according to claim 4, characterised in that the target distance only up to a predeterminable maximum value enlarged becomes.

6. Process according to one of claims 2 to 5, characterised in that the target distance only for the case changed becomes that the relative speed lies between the vehicle and at least a surrounding foreign vehicle a bottom predeterminable limit.

7. Process according to one of claims 1 to 6, characterised in that the true airspeed (v) on the vehicle speed of a lateral offset driving foreign vehicle (4,5) limited becomes.

8. Process according to one of claims 1 to 7, characterised in that in case of a track switching the true airspeed (v) of the vehicle (1) on a predetermined speed value limited becomes.

9. Process according to claim 8, characterised in that in case of a track switching the true airspeed (v) on that speed value limited becomes, with which the vehicle (1) drove more immediate before the track switching.

10. Process according to one of claims 7 to 9, characterized thus - that a track switching of the vehicle (1) is detected, - that for the moment the track switching the Fahrzeuggeschwindig keit on the same lane the preceding
Foreign vehicle (3) determined and as Maximalgeschwindig (Vmax) stored becomes keit - that the true airspeed (v) of the vehicle (1) becomes limited after carried out track switching on the maximum speed (Vmax).

11. Process according to claim 10, characterised in that a limitation of the true airspeed (v) of the vehicle (1) only with a track switching into a single, particular direction performed becomes.

12. Process according to one of claims 7 to 11, characterised in that the vehicle speed of a preceding, however lateral offset driving foreign vehicle (4,5) determined and as maximum speed (Vmax) for the true airspeed of the vehicle predetermined becomes.

13. Process according to one of claims 7 to 12, characterised in that the limitation of the true airspeed (v) of the vehicle (1) on the maximum speed (Vmax) after flow of a predetermined or minimum period canceled which can be determined becomes.

14. Process according to one of claims 1 to 13, characterised in that the position of the vehicle (1) in absolute coordinates certain and the relative position of the foreign vehicle (3.4, 5) regarding the vehicle (1) measured becomes.

15. Process according to one of claims 1 to 14, characterised in that the distance (D) to immediate ahead driving foreign vehicle (3) the determined and if the actual distance (D) is larger as a minimum distance between vehicle (1), which can be kept, and foreign vehicle (3), automatic on the minimum distance shortened becomes.

16. As well as spacer monitoring system for a vehicle, in particular spacer monitoring system to the carrying out the method after one of the claims 1 to 15, with measurement means to the detection of vehicle state quantities and vehicle Kenngrõ ssen to the detection of position and vehicle speed of at least a surrounding foreign vehicle (3, 4.5), with Regel-und control unit, in which in response of the vehicle state quantities and the distance and the vehicle speed at least surrounding foreign vehicle (3,4,5) in accordance with a deposited rule strategy actuating signals are generatable, which actuators in the vehicle (1) for adjustment a permissible distance to the foreign vehicle (3,4,5) and/or. a permissible true airspeed (v) of the vehicle (1) supply are cash, characterised in that the true airspeed (v) of the vehicle (1) and/or the target distance to that direct preceding foreign vehicle (3) as function of the vehicle speed of a lateral offset driving foreign vehicle (4,5) and/or the distance between several lateral offset driving foreign vehicles (4,5) is assignable.

17. Spacer monitoring system according to claim 16, characterised in that the measurement means a positioning mechanism to the determination of the absolute position of the vehicle (1) covers.

18. Spacer monitoring system according to claim 17, characterised in that the measurement means radar measurement means, infrared measurement means and/or a camera with image processing system to the measurement of relative speed and/or relative distance to the foreign vehicle (3,4,5) covers.

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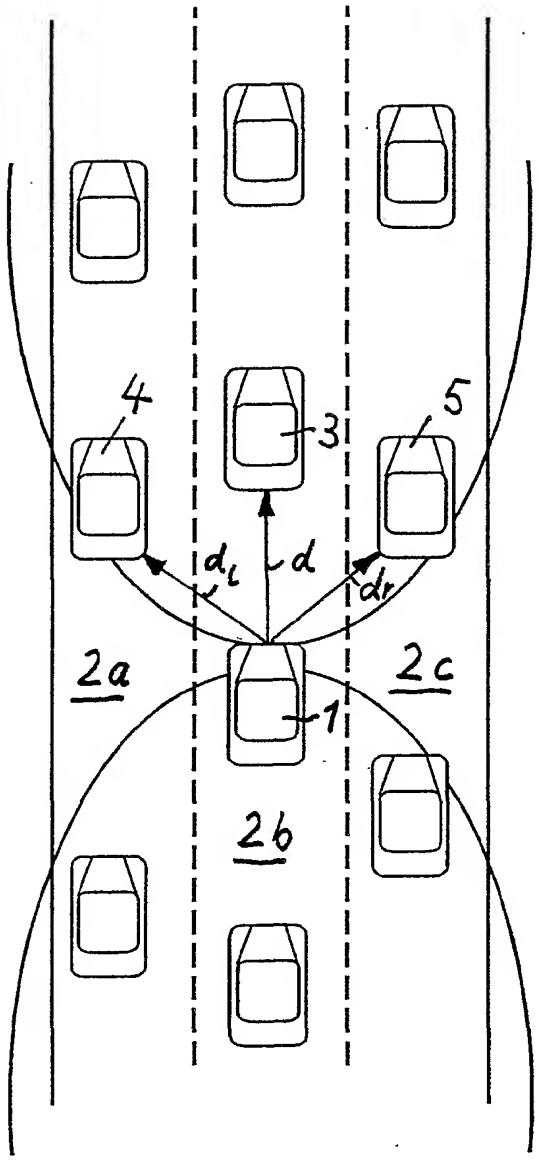

Fig. 1

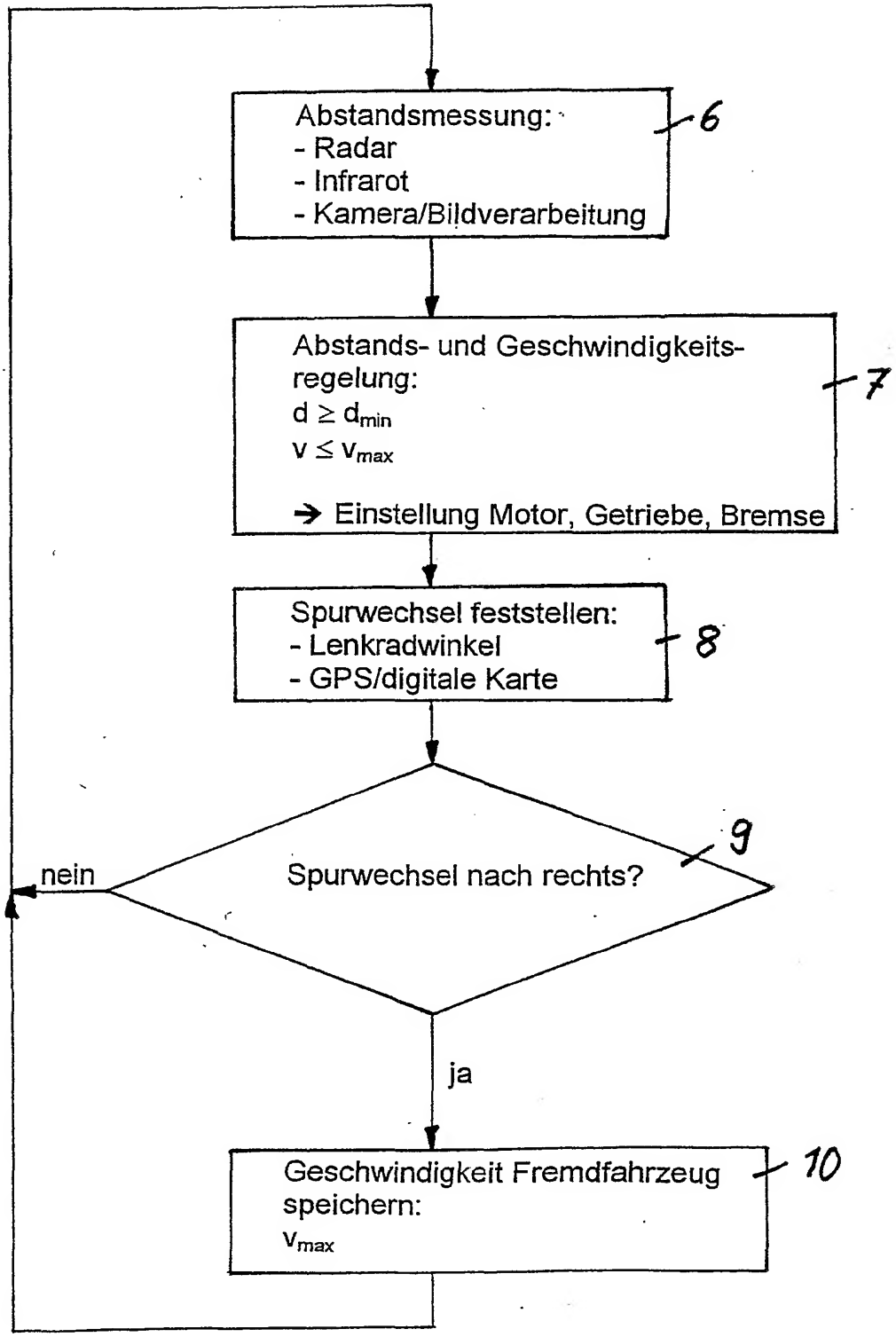
Abstandsmessung:
- Radar
- Infrarot
- Kamera/Bildverarbeitung
6
Abstands- und Geschwindigkeits-regelung:
$d \geq d_{min}$
$v \leq v_{max}$
→ Einstellung Motor, Getriebe, Bremse
7
Spurwechsel feststellen:
- Lenkradwinkel
- GPS/digitale Karte
8
Spurwechsel nach rechts?
9
nein
ja
Geschwindigkeit Fremdfahrzeug speichern:
v_{max}
10

Fig. 2